Naval EM Railgun Innovative Naval Prototype

3 August 2006

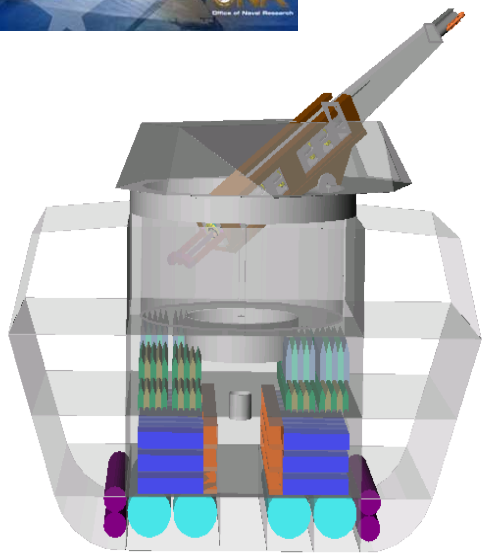
GENERAL ATOMICS
BAE SYSTEMS
BOEING
DRAPER LABORATORY
L3 communications Applied Technologies Pulse Sciences
Mayflower Communications™
IAP
ARA
ARL
ATK ALLIANT TECHSYSTEMS
Honeywell
SPARTA
Jackson Engineering
Engineering Technology and Development
TEXTRON Systems
Rockwell Collins
simulations
EMD
SAIC

NDIA NATIONAL DEFENSE INDUSTRIAL ASSOCIATION STRENGTH THROUGH INDUSTRY & TECHNOLOGY

The 2006 Naval S&T Partnership Conference is presented by NDIA with technical support from ONR

ONR

Navy Electromagnetic Railgun



Why is it important?

- Volume & Precision Fires
- Time Critical Strike
- All weather availability
- Variety of payload packages
- Scalable effects
- Deep Magazines
- Non explosive round/No gun propellant
  - Greatly simplified logistics
  - No IM (Insensitive Munitions) Issues
- Missile ranges at bullet prices

What is it?

- Gun fired with electricity rather than gunpowder
- Revolutionary *250 mile range in 6 minutes*
- Mach 7 launch / Mach 5 hit
- Highly accurate, lethal GPS guided projectile
- Minimum collateral damage

Who needs it?

- Marines and Army troops on ground
- Special forces clandestine ops
- GWOT
- Suppress air defenses

When?

- Initial 32MJ Test Capability 2008
- Feasibility Demo 2011
- System Demo 2015
- IOC 2020-2025

EM Railgun – Game Changing

ABOVE SENSIBLE ATMOSPHERE

Minimizes susceptibility to GPS jamming and simplifies deconfliction.

Ballistic Trajectory

GPS guidance, navigation, & control

500,000 ft

Hypervelocity Electromagnetic Launch (MACH 7.5)

Hypervelocity Impact (MACH 5.0)

Indirect Fire (200+ nm in 6 minutes)

Fixed & Relocatable Targets at Long Range

Direct Fire (Horizon in 6 seconds)

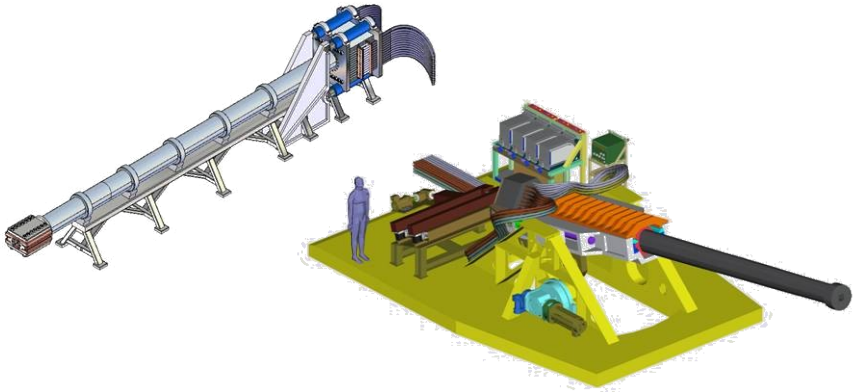
- Large Capacity Magazines
- No Propellants
- No Explosive Warheads
- Reduced Ship Vulnerability
- Simplified Logistics

- Long-Range
- Time-Critical
- Persistent
- All-Weather (24/7)
- No Unexploded Ordnance Issues

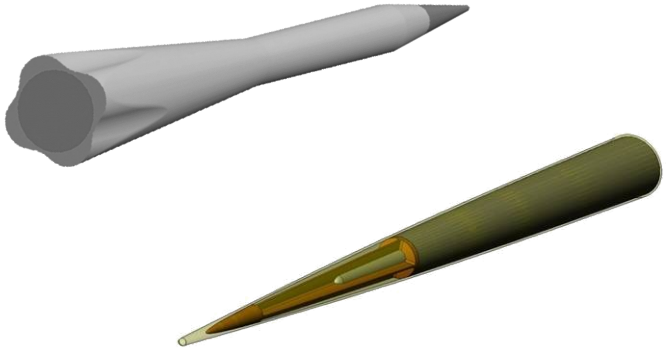
Support for Distributed Ops

Naval Railgun – Key Elements

Launcher



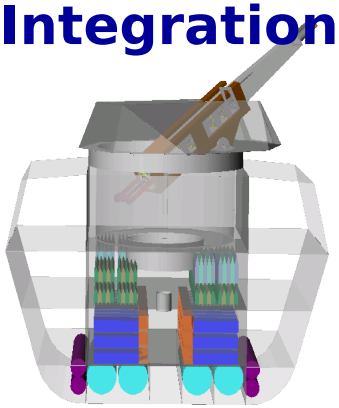
Projectile



Pulse Forming Network

Capacitors or Rotating Machines

Ship Integration



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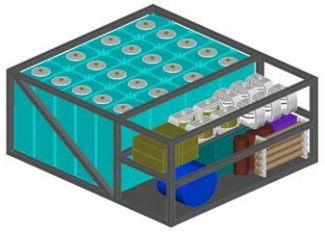
S&T Technology Challenges

- Launcher
  - Multi-shot barrel life
  - Barrel construction to contain rail repulsive forces
  - Scaling from 8MJ (state of the art) to 32MJ → 64MJ Muzzle Energy
  - Thermal management techniques
- Projectile
  - Gun launch survivability (45 kGee acceleration, Electromagnetic Interference Potential)
  - Hypersonic guided flight for accuracy
  - Lethality mechanics
- Pulsed Power System
  - Energy Density
  - Rep rate operation & thermal management
  - Switching
  - Torque management and multi-machine synchronization (rotating machine)



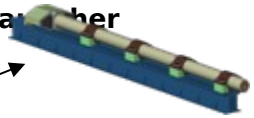
Path to Integrated System Demo

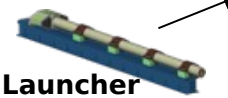
INP I

INP II

EM Lab Gun for Bore Life D

INP Phase I EM Railgun Demonstration La her



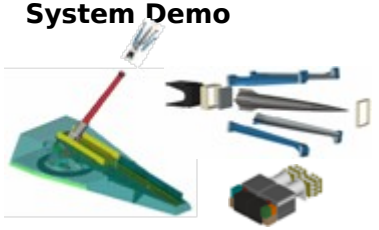


Launcher Technology Dev.

Launcher Trades & Concept Dev.

INP Phase II EM Railgun Demonstration Launcher

INP Phase II Long Range Integrated System Demo

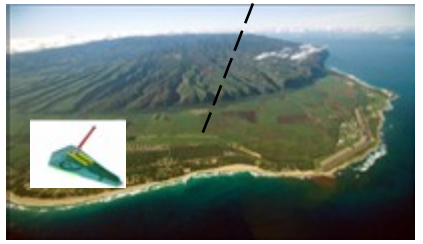


Projectile Trades & Concept Dev.

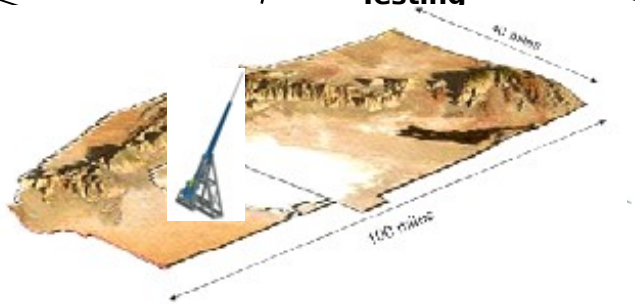
ILP Interface in bore dynamics

Endo-Exo Testing

Long-Range



Electromagnetic Test Facility



Velocity Powder Gun

ONR INP Phase 1 Objectives

- **Traceability** to 64MJ, 6-10 round / min indirect fire weapon system
- **Bore Life**
  - 32 Mega-Joule (Muzzle Energy) EM Lab Launcher
  - 10kg launch package; full muzzle velocity of 2.5km/sec
  - 20kg launch package with full current of ~5.5MA
  - Demonstrate more than 100 shot bore life
- **Containment**
  - 32 Mega-Joule Advanced Containment Launcher
  - 10kg launch package; full muzzle velocity of 2.5km/sec
  - 20kg launch package with full current of ~5.5MA
  - 1000+ round predicted containment structural barrel life
  - Design for thermal management at a rate of 6 round / min
  - Design launcher for minimal round dispersion
  - Transportable on pallets and/or in sea containers,
  - Consider marine environment

ONR INP Phase I Program

FY05	FY06	FY07	FY08	FY09	FY10	FY11

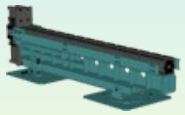
Executive Steering Committee Conclusion and Recommendation

Program Initiation Aug 05

Initial 8MJ Test Capability

Initial 32MJ Test Capability

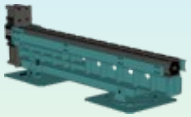
Go – No Go Decision Point Aug 09



BAE

32MJ Lab Gun For Bore Life Development

Launcher Bore Life Development



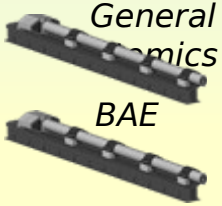
32 MJ LAUNCHER 100 SHOT BORE LIFE DEMO

A

B

C

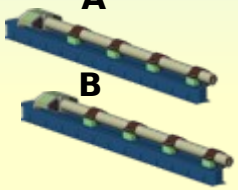
Exercise Options



General Atomics

BAE

Advanced Containment



A

B

Concept Design

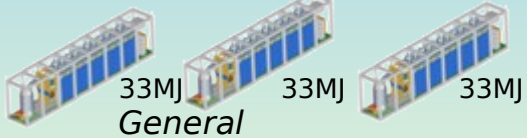
Technology Development & Preliminary Design

Detail Design & Fabrication

32 MJ ADVANCED CONTAINMENT DEMO

EM Test Facility NSWCDD

100MJ Capacitor Bank For Launcher Testing

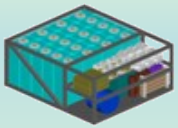


33MJ

33MJ

33MJ

General Atomics



Advanced Capacitor Development

Rotating Machine Component Development

Multiple Awards

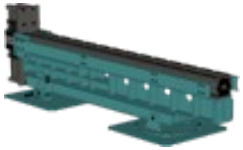
Boeing

Draper

Projectile Trades & Develop 4 Year Plan

Integrated Launch Package (ILP) Development

Launcher and Projectile Thrusts



Launcher

Full Bore
¾ Length
Full Current
Full Mass

Full Velocity
½ Mass

Advanced Containment

Projectile

ILP In-Bore Dynamics

Flight Body Aero-Thermal Guidance Scheme Lethality

GNC

- Launcher Technology
  - Bore materials and geometry
  - Advanced containment techniques
- Develop Integrated Launch (ILP)
  - Armature
  - Sabot, bore riders
  - Nominal projectile shape
- Critical Focus Areas
  - Launch survivability
  - Hi-Gee GNC
- Leverage Other Programs
  - Conventional Guided Munitions
  - Re-entry Flight Body Vehicles

Summary

- Naval EM Railgun is a “Navy after Next” Game Changer
- Navy EM Railgun INP Program is Established
- Risk Mitigation
  - Establish Bore Life Consortium
  - Advanced Containment Launchers – Competitive solutions
  - Integrated Launch Package (ILP) and Projectile development
  - Understand Ship and Weapons System Requirements Integration

Challenges Understood and Being Addressed

Railgun INP Contact Information

We need your help in moving this innovative effort forward.

Ideas/comments/etc. should be sent to:

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